Tomato- A Potential and High Value Crop for Quality Seed Production

H R Sharma

YSPUHF, HRS Kandaghat, Solan

INTRODUCTION

BOTANICAL NAME- *Solanum lycopersicum*

FAMILY- Solanaceae

- Tomato is one of the most popular and widely grown vegetables in the world ranking second in the importance to potato in many countries. It is one of the most important "protective foods" because of its special nutritive value and one of the most versatile vegetable with wide usage in Indian culinary tradition.
- Tomato is popular because it supplies Vitamin C and adds variety of colors and flavors and to the foods. The ripe fruits are taken as raw or made into salads, soups, preserve, pickles, ketchup, puree, paste and many other products (Chadha, 2001). It has very few competitors in the value addition chain of processing.

IMPORTANCE

- In terms of value, it comes next only to potato and sweet potato in India, but as a processing crop, it ranks first among vegetable crops (Sandhu *et al.*, 1990).
- Its fruits are good source of vitamin A and vitamin C as well as contain antioxidants such as lycopene which prevents cancer (Bhutani and Kallo, 1983).
- It is a rich source of vitamin-A (4.0-mg/100g), vitamin C (15-30mg/100g), total soluble solids (4-7%), acidity (7.5-10mg/100ml) and as well as contains antioxidants such as lyopene (1.82-5.24 mg/100g)

which helps to keep cholesterol down and bolster resistance to cancer (Watznman, 2ooo).

AREA AND PRODUCTION

- Worldwide production of tomatoes reached 170.75 million tonnes in 2014 over an area of 5.03 million hectares (FAO,2017).
- It is one of the most popular vegetable in India and grown in tropical, subtropical and mild cold climate regions on an area of 791 thousand hectares with an annual production of 17398 metric tonnes (NHB, 2016).
- Tomato is also an important off-season crop of Himachal Pradesh and is grown during summer and rainy season as the climatic conditions are congenial for optimum plant growth and yield. The annual production of tomato in Himachal Pradesh is 430.79 metric tonnes from an area of 10.37 thousand ha (NHB, 2016).

HEALTH BENEFITS OF TOMATO SEEDS

- Improves vision -Tomato seeds are a rich source of Vitamin A help in improving the eyesight.
- Promotes bone health- Seeds are rich in Vitamin K and calcium.
- Improves immunity- Because of the presence of Vitamin C, it helps to improve the immunity system of the body.
- Fights obesity- The fibre and niacin content of tomato seeds do the good job pf lowering the bad cholesterol level.
- Anti Inflammatory Properties- The lycopene and beta carotene present in tomato seeds helps in eradicating the free radical damage from the body which is in turn helps in reducing the problem of inflammation.
- Prevents heart diseases- The Vitamin B6, potassium and folate content of tomato seeds help in reducing the problem of hyper tension and reduce risk of harmful heart diseases.

IMPORTANCE OF QUALITY SEEDS

- They are genetically pure (true to type).
- The good quality seed has high return per unit area
- Less infestation of land with weed seed/other crop seeds.
- Less disease and insect problem.
- Uniform in plant population and maturity.
- The quality seed respond well to the applied fertilizers and nutrients.
- Good seed prolongs life of a variety.
- They are vigorous, free from pests and disease.
- High produce value and their marketability.
- Crop raised with quality seed are aesthetically pleasing.
- It is estimated that good quality seeds to improved varieties can contribute about 20-25% increase in yield.

FLORAL BIOLOGY

- Inflorescence - Extra-axillary cyme with dichotomous or polychotomous branching .
- Flower- Ebracteate, bright yellow, chasmogamous, pentamerous, actinomorphic, hypogynous, hermaphrodite, with pistil enveloped by a solid tube formed by the stamens . The flower cluster is called a truss.
- Calyx – 5 sepals, united, alternate with petals, persistant , possesses trichomes.
- Corolla – Bright yellow in color with 5 petals, alternate to sepals .
- Androecium- Stamens 5, greenish yellow, free at the base and united at the top. The anthers dehisce longitudinally.
- Gynoecium- Bicarpellory syncarpous superior ovary.
- Fruit – It is a berry.
- Anthesis starts in morning around 6 am and continues till 11.00 a.m. Anther dehiscence is longitudinal. It occurs 1-2 days after opening of corolla. Maximum flower opening is between 7 to 9 am .

- Stigma receptivity is 16 to 18 hrs before anthesis and remains upto 5 to 6 days after anthesis.
- Pollen remains viable for 2 to 5 days (18 - 25°C) & upto 6 months in a dessicator (5°C) .

BREEDING BEHAVIOUR

- Tomato is a self- pollinating crop. Self pollination varies between 94 - 99%. The best pollinator for tomato flower is a bee that Buzz and pollinate the flower Or artificially hand shaking or the use of some brush may serve the purpose.
- Self-fertilization being favoured by the position of the receptive stigma within the cone of anthers and the normal pendant position of the flower.
- Though the stigma is receptive at the time of anthesis, anthers do not dehisce until about 24-48 hours later.
- Cross-pollination of tomato flowers to the extent of about 5 percent may occur through insects.

Method of Seed Production in case of Open-pollinated and Hybrid Varieties

1. **CLIMATE AND SOIL**
   - Tomato is a day neutral plant .
   - It is a warm season crop. It does not perform well at temperature 35 °Cas well as below 15°C. Daily mean temperature of 22-26°c is more critical.
   - Optimum night temperature is15-21°c.
   - Low night temperature of 13°c or below fruits fail to setting.
   - Mean daily temperature over 25°c decrease fruit setting in tomato .
   - Tomato grows practically in all soils from light sandy to heavy clay. Light soils are preferred for an early crop, while clay loam and silt loam soils are well suited for heavy yields.

2. LAND REQUIREMENTS

- The field selected for seed production should not have been grown with it kind of crop during preceeding season.
- Selected land should be free from volunteer plants.
- Select a sunny spot to promote maximum production of flowers and fruit.
- Avoid fields where the previous crop was tomato; this prevents the new seed crop from being contaminated with seeds from volunteer tomato plants.
- Avoid fields where the previous crop was sweet potato or a solanaceous crop (tomato, pepper, eggplant or white potato); this prevents the build-up of diseases and insects.
- Growing tomato after paddy rice reduces the incidence of diseases and nematodes.

3. SOWING SEASON AND SEED RATE

- Tomatoes can be grown throughout the year. The nursery is raised from june to early November depending on the region and climatic conditions. But the best season for seed crop is May- June. The crop raised in this season produced maximum quantity of good quality seed.
- Open pollinated varieties : 400-500g/ha
- Hybrids : 125-175g/ha
- 1gram contains 250-300 seeds.

4. NURSERY SOWING AND SEEDLING PRODUCTION

- Tomato seedlings are raised in the nursery beds as well as in soil less cultures.

IN OPEN FIELD CONDTIONS

- September-October is the optimum time for sowing seeds in the nursery for crop production in the plains.
- For summer crop in the mountain areas the optimum time for raising seedlings is March/April depending on the altitude.
- Seeds are sown in line on a well-prepared seedbed and lightly covered with soil.
- After 7-10 days of sowing the young seedlings are transplanted on the second bed at a distance of 2-3 cm in both ways. The seedbeds should be irrigated immediately after transplanting.
- The seedlings should be protected from strong sun and heavy rains.
- 300-350 g of urea dissolved in 30 liters of water can be sprinkled on nursery beds after about a week of transplanting the young seedlings in the second bed to get healthy seedlings.

IN PLUG TRAYS

- Fabricated by using 40 mesh UV stabilized nylon net and half inch GI pipes with white double door with a provision of a hanging yellow sticky card inside the net house is technically suitable for raising virus free healthy seedling of tomato, chilli and sweet pepper in small area of green house in plastic multi-celled plug tray by using soil less media for growing vegetables either for season or for off-season cultivation.
- To raise healthy, vigorous seedlings of different cucurbits.
- Coco peat, vermiculite and perlite is used in 3: 1: 1 ratio as a media for raising seedling.

5. MAIN FIELD PREPARATION

The field choosen for seed crop should not be grown with any variety or species of tomato as a previous crop. The field should be ploughed 3 to 4 times to get a fine tilth and formed ridges and furrows deoending upon the variety for cultivation.

6. TRANSPLANTING

The seedlings will be ready for transplanting at 25- 30 days after sowing . Healthy and vigorous seedlings that have produced five leaves should be used for planting in the main field, to have a good establishment and to achieve uniform stand in the field. Field should be irrigated to the field capacity and planted in the evening after 3.30 pm. Gap filling should be attended within a week of planting to maintain the desired population.

7. SPACING

- Open pollinated varieties are planted at a spacing of 90x90cm in case of indeterminate types while at 75x75cm in case of determinate types.
- Hybrid varieties are planted at a spacing of 90x60cm in case of indeterminate types while at 60x60cm in determinate types.

8. IRRIGATION

Tomato needs very careful irrigation , which should be sufficient at right time. Salinity of water has detrimental effect on flowering, fruit set, field and fruit quantity. A relatively dry period followed by sudden heavy watering during trinity period may cause cracking of fruits.

9. WEED MANAGEMENT

Application of pendimethalin @ 1.0 kg a.i. /ha as pre-emergence and post emergence at 10 days after planting is recommended for seed crop.

10. ROUGING

- The lines should be as pure as possible. The volunteer plants and off types should be removed during Pre- flowering, flowering, post-flowering, and harvest stages.
- Know the plant habbit, leaf type, immature fruit characters(e.g. shape, size, and shoulder colouring) of each line.Regularly inspect the plant.Remove any off type (usually inferior) or virus-infected plants immediately.

11. HARVESTING

- Harvest at full mature, preferably at pink or red ripe stage.
- This enables the seed to develop normally and fully.
- If fruits are harvested at an earlier stage, place them in a covered, cool dry place for three or four days until they become red ripe.
- Only completely colored and matured seed fruits are harvested.
- Maintain 30 fruits for large-fruited parent, 40 fruits for medium-fruited parent, 50 or more fruits for small-fruited parent.

HYBRID SEED PRODUCTION

ADVATAGES OF HYBRID VARIETIES OVER OPEN POLLINATED VARIETIES

- Higher yields
- Early maturity and more uniformity
- Better fruit quality and disease resistance
- With all of these advantages, many farmers prefer to sow hybrid seeds inspite of the higher seed costs. The demand for hybrid seeds can open a new market for growers interested in seed production . Hybrid tomato seed production is not easy. First, it requires much labor. Fortunately, this is not a problem in developing countries where affordable labor is available. Second, it requires the mastery of special skills and close attention in different aspects.

1. SELECTING PARENTS AND SOWING

- Hybrid seed production involves the crossing of a female line to a male line. Either line can be the female or male parent, but normally the best seed yielder is selected as the female parent.

- Both parents should be pure, preferably being self pollinated for more than six generations (this is called *inbreeding). The inbred parents are* selected for their desirable traits (e.g., high yields, disease resistance, fruit quality, earliness, etc.).
- It is important to have plenty of pollen available for making hybrid crosses. Since tomato vines bloom profusely, a ratio of 1 male for every female plants is recommended.
- Seeds of male plants are sown three weeks earlier to ensure that pollen is available from the beginning of operations.

2. SPECIAL CULTURAL PRACTICES

2.1 Plant Location and Spacing

- Male lines are usually planted in a different location to facilitate operations and avoid shading from competing plants. Select a sunny spot to promote maximum production of flowers and pollen.
- Male and female lines are planted in double-row raised beds, with centers of beds spaced 150 cm apart.
- For female lines, plants are spaced 50 cm apart within the row.
- Male plants are spaced 40 cm apart to maximize flower production per hectare.

2.2 Staking and Pruning

- The female parent is staked. Staking facilitates the handling of plants during emasculation and pollination.
- Staking also keeps the ripening fruits above the ground and prevents rotting.
- Plants are trellised along with plants from the adjoining bed so that work operations are done on the raised bed rather than in the furrow.
- Among male lines, only indeterminate types need to be staked. If male lines are staked, trellising can be done within beds or across adjoining beds .

2.3 Removing off types

- The male and female lines must be 100% pure. Know the plant habbit, leaf type, immature fruit characters(e.g. shape, size, and shoulder colouring) of each line.
- Regularly inspect the plant.
- Remove any off type (usually inferior) or virus-infected plants immediately before the hybridization procedures begin. Symptoms of viruses that attack tomato include yellow mottling of leaves; severe curling, cupping or other distortion of foliage; and stunting of plants.

2.3 Emasculation

To prevent self-pollination, remove the stamens from the flower buds of the female line before they shed their pollen . This process is called *emasculation.* Emasculation begins about 55-65 days after sowing. Flower buds from the second cluster which will open in two to three days are chosen for emasculation . The petals will be slightly out of the flower bud but not opened, and the corolla color is slightly yellow or even paler. Flowers from the first cluster are removed.

To help identify the fruits from selfed fruits at the time of harvest, cut the corolla and calyx.

2.4 Pollen collection

- Collect flowers from the male parent to extract pollen. The best time for pollen collection is during the early morning before the pollen has been shed.
- Remove the anther cones from the flowers and put them in glassine envelopes.